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Indian Standard

CLASSIFICATION AND METHODS OF TESTS FOR NON-IGNITABLE AND SELF-EXTINGUISHING PROPERTIES OF SOLID ELECTRICAL INSULATING MATERIALS

(Incorporating Amendment No. 1)

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Price Group 6

Indian Standard

CLASSIFICATION AND METHODS OF TESTS FOR NON-IGNITABLE AND SELF-EXTINGUISHING PROPERTIES OF SOLID ELECTRICAL INSULATING MATERIALS

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Indian Standard

CLASSIFICATION AND METHODS OF TESTS FOR NON-IGNITABLE AND SELF-EXTINGUISHING PROPERTIES OF SOLID ELECTRICAL INSULATING MATERIALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 13 October 1967, after the draft finalized by the Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 Determination of non-ignitable and self-extinguishing properties of solid electrical insulating materials is of great importance for selecting proper insulating material for electrical equipment where fire hazards are anticipated due to the normal operating conditions of the equipment.

0.3 The readiness with which a material burns depends upon the conditions of test. Such tests are necessarily empirical. Under a given condition, a material may fail to ignite. Under a more severe condition, it may be ignited and after removal of the source of ignition may be self-extinguishing. Under a still more severe condition, the same material may continue to burn freely. It is for this reason that, in defining such terms as are resisting, free burning, non-ignitable and self-extinguishing, it has been necessary to prescribe certain conditions.

0.4 After examining a large number of tests, which have been developed, a series of tests embodying conditions which most nearly correspond to working conditions in practice have been selected. The user who desires to specify a property, such as non-ignitability has to select the test most appropriate to his working conditions and to prescribe certain limits with which the materials have to comply on test.

0.5 For special purposes and for samples of a special nature, it may be necessary to specify other limits and sizes of sample than those suggested in this standard; the actual figures for use in a particular case shall be based on experience and may necessitate experimental testing of available materials known to be suitable or unsuitable.

0.6 In preparing this standard, assistance has been derived from the following:

B.S. 738 : 1937 Definitions for the non-ignitable and self-extinguishing properties of solid electrical insulating materials including classification and methods of test. British Standards Institution.

66/3994 Draft British Standard specification for asbestos cement boards (incombustible) for electrical purposes (*revision of* B.S. 3497 : 1962). British Standards Institution.

0.7 This standard is one of a series of Indian Standards on methods of testing for electrical insulating materials. Other standards published so far in the series are:

IS : 2259-1963 Methods of test for determination of insulation resistance of solid insulating materials

IS : 2260-1963 Recommendations for the conditioning and testing of electrical insulating materials

IS : 2584-1963 Method of test for electric strength of solid insulating materials at power frequencies

IS : 2824-1964 Method for determination of the comparative tracking index of solid insulating materials

IS : 3396-1965 Methods of test for volume and surface resistivities of electrical insulating materials

0.8 This edition 1.1 incorporates Amendment No. 1 (October 1979). Side bar indicates modification of the text as the result of incorporation of the amendment.

1. SCOPE

1.1 This standard covers the classification and methods of test applicable to the non-ignitable and self-extinguishing properties of solid electrical insulating materials.

2. TERMINOLOGY

2.0 For the purpose of this standard; the following definitions shall apply.

2.1 Arc Resisting — The material is known to be arc resisting if it resists under the conditions prescribed in Appendix A, the action of an electric arc.

2.2 Burning — To undergo combustion (*see* **2.4**).

2.3 Carbonization — The condition in which part of the material is dissociated and set free and the carbon constituent is left behind. Carbonization is usually the result of heating, but may also be brought about by chemical action.

2.4 Combustion — The combination of a combustible material with a supporter of combustion, producing heat and sometimes both light and heat.

2.5 Igniting — To ignite; to set on fire.

2.6 Ignitable — A material which is capable of being ignited.

2.7 Free Burning — A material which burns freely and continues to do so even after the source of ignition is removed.

2.8 Inflammable — A material which is capable of being easily ignited.

2.9 Non-ignitable — A material which when heated as prescribed in Appendix A neither burns nor gives off inflammable vapours.

2.10 Self-Extinguishing — A material which having ignited when heated as prescribed in Appendix B does not continue to burn for more than a minute after the source of ignition is removed.

3. CLASSIFICATION AND GRADING

3.1 General — The following clauses describe the various hazards likely to be encountered in service by the non-ignitable and self-extinguishing insulating materials.

3.2 Power Arc — The electric arc is the most severe artificial heat source known. Neither insulating materials nor metallic conductors are able to withstand the arc for any length of time. The worst service conditions, from this point of view, are experienced in arc-chutes, switch-barriers, contactor panels, etc.

3.2.1 *Test* — The carbon arc test (*see* Appendix A) subjects the specimen to the influence of a 10-ampere arc between two 7-mm diameter carbon electrodes which are maintained in light contact with the surface.

3.2.2 *Grading* — Materials subjected to the carbon arc test may be graded by the time which elapses before the arc penetrates a test piece of specified thickness.

3.3 Explosive Arc — An explosive arc accompanies the blowing of a fuse and is consequently a common service condition in connection with heavy duty fusible cut-outs. When insulating material is subjected to an explosive arc two dissimilar effects take place. The material may disintegrate and become pitted or the surface may become carbonized or rendered conductive or both by a deposit of the products of the explosive arc.

3.3.1 *Fuse Wire Test* — When tested, as described in Appendix C, boards of Classes 1, 2 and 3 shall withstand ten applications of the fuse wire test without the surface being rendered conducting. This condition is determined by a measurement of the leakage current made immediately after each fusing and this current should not exceed one ampere.

3.3.2 *Grading* — Materials subjected to the explosive arc test may be graded for:

a) resistance to disintegration by the depth of the pits or grooves below the general level, produced by a specified number of applications; and

b) resistance to surface conduction by the number of applications withstood by the specimen before developing conduction (leakage current exceeding one ampere or by the condition of the surface

after a maximum of ten applications. The following conditions may occur:

1) *Worst condition* — Surface depreciation bad enough to maintain arc.
2) Arc extinguished but conducting track left which passes sufficient current to operate a low-reading ammeter.
3) Arc extinguished, leaving track having insulation resistance less than one megohm as measured between the terminals of the undisturbed specimen.
4) Arc extinguished, leaving local carbonization, but high resistance exceeding one megohm due to discontinuity of track.

3.4 Weak Intermittent Arcs — Tumbler-switches, lampholders, adapters, plugs, plug-sockets and installation accessories generally are likely to be subjected to weak intermittent arcs produced by the breaking of a circuit carrying a limited load. These arcs, although by no means severe individually, are likely to produce progressive deterioration leading to ultimate failure.

3.4.1 No suitable test method has been developed as yet which would simulate representative working conditions. In case a test is desired it should be planned to simulate in all essential particulars the working conditions of the particular application.

3.5 Flame — In the case of naked flame, the insulating materials are subjected to the usual fire hazards.

3.5.1 *Test* — The spirit burner test (*see* Appendix B) provides a convenient means of studying the relative facility with which a material ignites on exposure to flame, or having ignited, extinguishes itself on removal of flame.

3.5.2 *Grading* — Materials subjected to the standard flame of the test in **3.5.1** may be graded for:

a) ignitability by the time of exposure before ignition occurs (*see* Note 1), and
b) self-extinction by the time burning continues after removal of the flame (*see* Note 2).

NOTE 1 — It is not advisable to grade materials for ignitability when the time of ignition is less than 5 seconds.

NOTE 2 — Limiting values of time, for inclusion in material specifications, shall be associated with specified ambient draught conditions.

3.6 Contact with Glowing Hot Body — There are service conditions where insulating materials are in direct contact with glowing hot body, for example, in electric heating devices and certain wire wound resistances.

3.6.1 *Test* — The glowing hot rod test (*see* Appendix D) provides a means for studying both the temperature at which a material ignites when in contact with a hot body and the relative extent of the damage sustained by these materials at specified temperature for a specified period.

3.6.2 *Grading* — The material may be graded by the temperature of the hot body to cause ignition and by the extent of the destruction of the specimen when subjected to contact under specified conditions.

3.7 Radiant Heat — Insulating materials used in electric furnaces (for example, terminal boards) and high power lamps are subjected to radiant heat which may tend to cause ignition, disintegration or other changes.

3.7.1 *Test* — The radiant heat test (*see* Appendix E) subjects the test piece to controllable heat rays from the glowing walls of a cylindrical muffle and provides means for the ignition of any inflammable gases which may be given off in the process.

3.7.2 *Grading* — The materials may be graded by the temperature at which ignition or other specified changes take place.

3.8 Contact with Intermittent Sparks — Commutators, controllers and apparatus for operating flashing signs by means of rotating contacts, may subject the insulating materials used in their construction to severe operating conditions. This happens when the spark, due to normal rupture of the circuit, impinges upon the insulation. To a large extent, trouble from this cause may be avoided by careful design methods, such as undercutting and air-spacing. Nevertheless designers of certain commutating devices may have to select materials for service where sparking at rubbing contacts is anticipated.

3.8.1 *Test* — The destruction of insulating materials by rotating contact is of a nature that cannot be simulated by a standard test. The tests, to be of any value, should reproduce the service conditions in close detail.

APPENDIX A

(*Clauses* 2.1,2.9 *and* 3.2.1)

METHOD OF CARRYING OUT CARBON ARC TEST

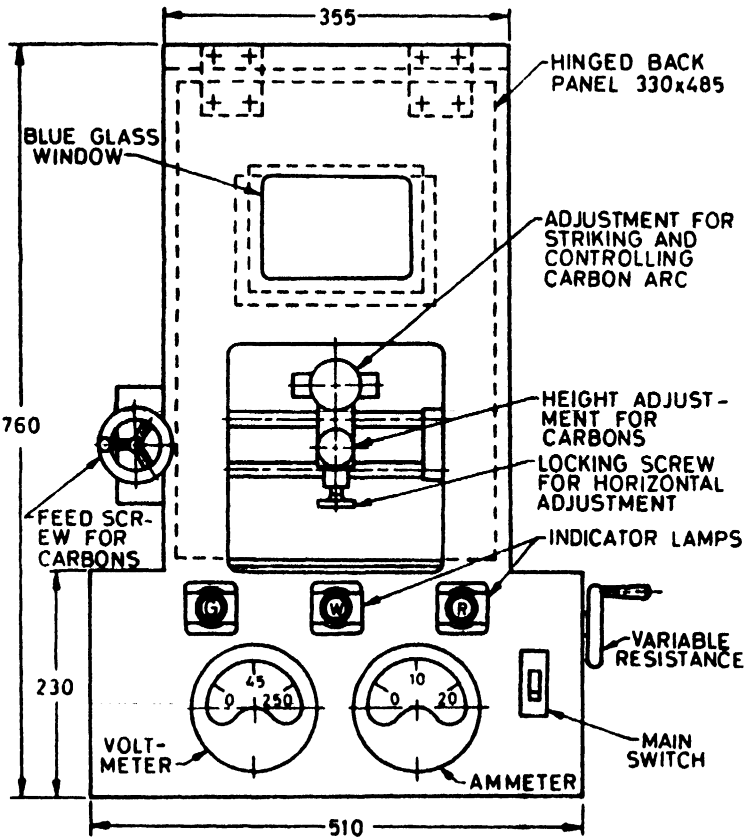
A-1. TEST PIECE

A-1.1 From the board under test, cut four test pieces each about 100 mm square and condition in accordance with Appendix F. For boards of nominal thickness not exceeding 6.35 mm, use test pieces of

the thickness of the board under test; for thicker boards reduce the thickness of the test piece to 6.35 mm by machining one surface.

A-2. APPARATUS

A-2.1 Use apparatus of the type shown in Fig. 1, 2 and 3.

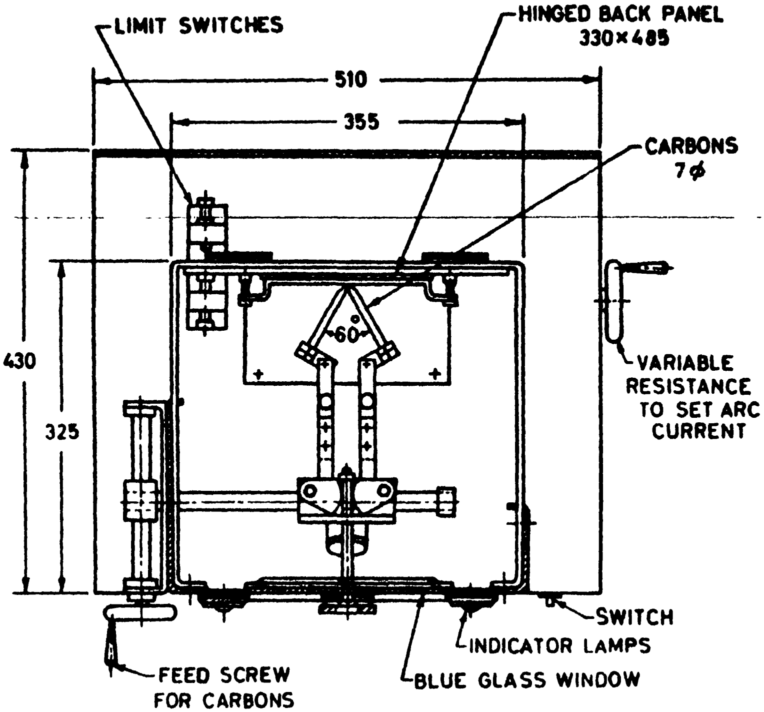


All dimensions in millimetres.

FIG. 1 APPARATUS FOR CARBON ARC TEST (FRONT ELEVATION)

A-2.2 The test piece is attached to a vertical backplate of suitable arc and heat resisting material faced with brass and suspended by hinges. The carbons are 7 mm diameter. They lie in a common horizontal plane and are inclined at an angle of 60° to each other and to the plane

of the test piece. The pressure of the carbons on the test piece is indicated by means of the green and white lamps while penetration of the test piece by the arc is shown by the red indicator lamp.



All dimensions in millimetres.

FIG. 2 APPARATUS FOR CARBON ARC TEST (PLAN VIEW)

A-3. PROCEDURE

A-3.1 Make the test under conditions which allow observation of any audible cracking of the test piece.

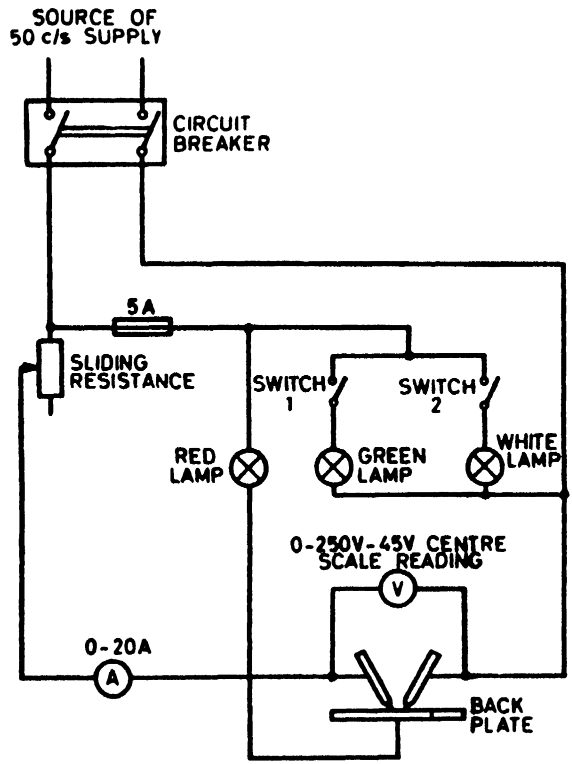
A-3.2 When the test piece is reduced in thickness for test, have the arc impinge on the original (unmachined) surface. Strike on ac 50 c/s arc between the two carbons and then adjust the voltage and current to 45 V and 10 A respectively. Move the carbons forward by means of the hand-wheel until the green lamp is extinguished but not so far forward as to illuminate the white lamp. Start timing the test immediately the green lamp is extinguished. When necessary, re-adjust the voltage and

current to the stated values and keep them constant as far as possible. Maintain the position of the hinged panel throughout the test so that neither the green nor white lamp is illuminated; this may be assured by a preliminary trial before the arc is struck.

A-3.3 When the red lamp lights, indicating that the arc has penetrated the test piece, or when cracking of the test piece is observed, stop the test and record the duration of the test.

A-4. RESULT

A-4.1 Calculate the mean time for penetration or cracking of the four test pieces.



NOTE 1 — Switch 1 is arranged so that it opens when the carbons cause an initial movement of the hinged panel of about 1·6 mm.

NOTE 2 — Switch 2 is arranged so that it closes when the hinged panel has been pushed forward 9·5 mm.

FIG. 3 CIRCUIT DIAGRAM FOR CARBON ARC TEST

APPENDIX B

(*Clauses* 2.10 *and* 3.5.1)

METHOD OF CARRYING OUT THE SPIRIT BURNER TEST

B.1. PREPARATION OF TEST PIECE

B-1.1 Take three test pieces 15 mm wide of the thickness of the board under test and of sufficient length to give a free length of not less than 100 mm when clamped as described in **B-3.2**. Condition the test pieces in accordance with Appendix F.

B-2. SPIRIT BURNER

B-2.1 Use a spirit burner of the pattern shown in Fig. 4 and having the essential dimensions given.

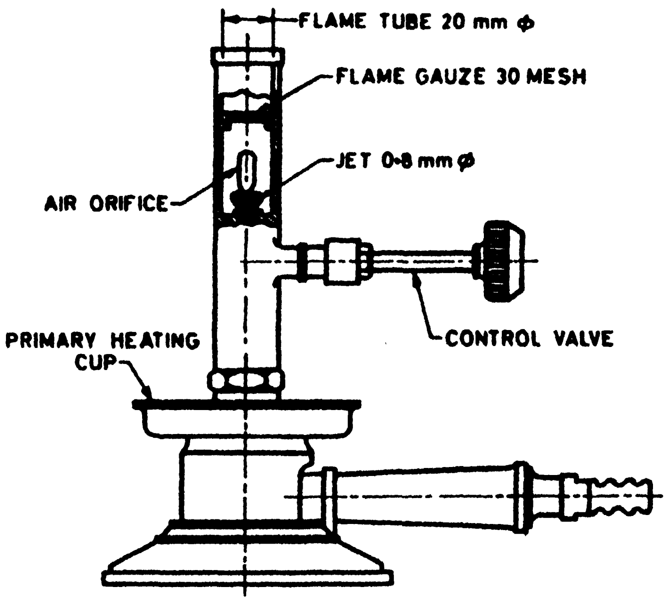


FIG. 4 SPIRIT BURNER

B-2.2 Use good quality 66 O.P. industrial methylated spirit containing 5 percent of wood naphtha as the fuel.

B-3.1 PROCEDURE

3.1 Operate the burner with a control valve more than one half turn open and with the level of the fuel in the reservoir 750 ± 75 mm above the base of the burner. Confirm the satisfactory operation of the burner by inserting a bare copper wire 0.71 mm diameter, having a free length of not less than 100 mm in the flame of the burner in the position to be occupied by the test piece. The flame is satisfactory for this test if the wire melts in less than 6 seconds.

B-3.2 With the burner functioning satisfactorily, clamp the test piece so that it rests in the flame of the burner with its long axis horizontal and the 15 mm dimension facing the flame 50 mm above the top of the burner. Not less than 100 mm of the test piece is to project from the jaws of the clamp and the end of the test piece is to be vertically above the edge of the burner as shown in Fig. 5.

B-3.3 Subject the test piece to the flame for one minute.

B-3.4 In the case of non-ignitable boards, in subdued light, verify any apparent burning of the test piece by momentary removal of the flame. Combustion is established if the test piece continues to burn for more than one second after removal of the parent flame at any time between 5 and 60 seconds.

B-3.5 In the case of self-extinguishing boards, remove the flame and note the time for which the test piece continues to burn. If the flame reaches to within 25 mm of the clamp, discard the results and test a new and longer test piece to ascertain the time required for extinction. Determine the mean value of tests on three test pieces.

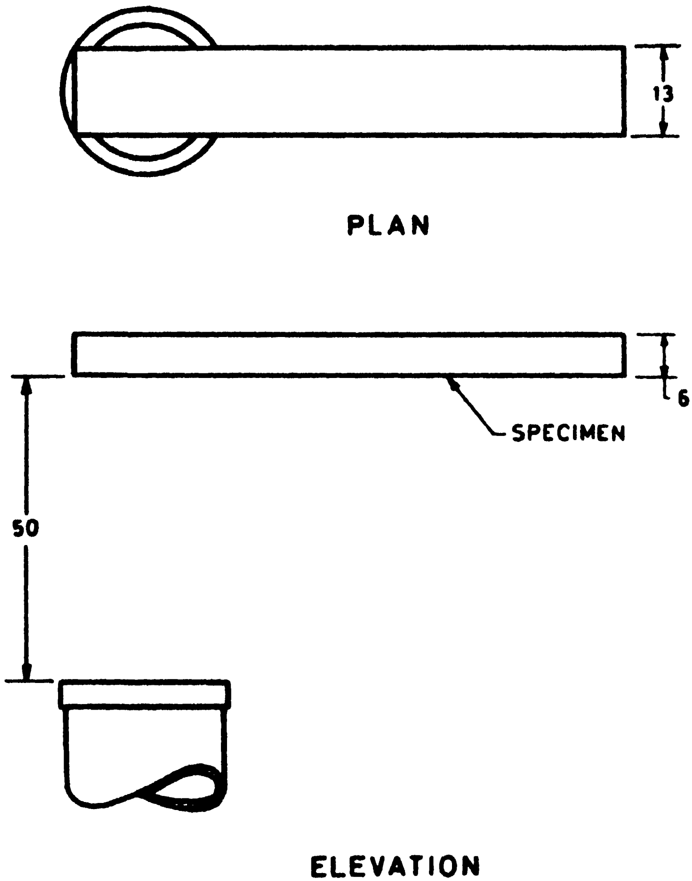
APPENDIX C

(*Clause* 3.3.1)

METHOD OF CARRYING OUT THE FUSE WIRE TEST

C-1. TEST SPECIMEN

C-1.1 The test specimen shall consist of two pieces of the material of 180 mm long and 50 mm wide. Both pieces shall be flat and free from surface defects. Two holes should be drilled to make it suitable for mounting as shown in Fig. 6. These two boards together comprise a single test piece which is conditioned before test in accordance with Appendix F.

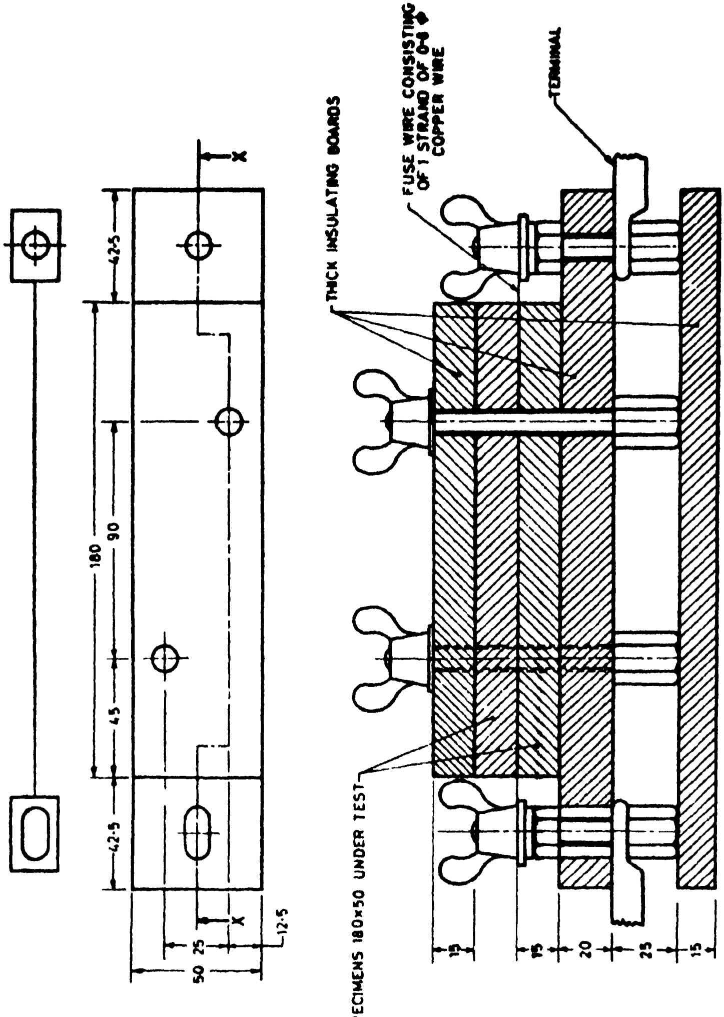


All dimensions in millimetres.

FIG. 5 ARRANGEMENT FOR SPIRIT BURNER TEST

C-2. CLAMPING ARRANGEMENTS

C-2.1 The specimens shall be clamped together with their working surfaces facing each other with a 0.75 mm diameter bare copper fuse wire lying centrally between them. The combined test piece together shall be clamped between two pieces of suitable insulating materials by means of two bolts 90 cm apart to give a general arrangement as shown in Fig. 6. The ends of the fuse wire shall be connected to the other two bolts, which act as terminals.



SECTION XX

All dimensions in millimetres.

FIG. 6 ARRANGEMENT FOR FUSE WIRE TEST

C-3. ELECTRICAL CIRCUIT

C-3.1 The electrical circuit shall be capable of causing a current of 100 A from a 12 V battery to flow through the copper wire thus fusing it within 10 seconds at a final current of not less than 98 A. Immediately the wire has been fused, 50 c/s voltage of 500 ± 10 V peak shall appear across the fused ends of the wire, the voltage being obtained from a specially designed transformer having its secondary in series with the fuse blowing circuit. Ammeters shall be provided to indicate whether correct fusing current is flowing and also to indicate fault current down to less than 1 A rms should the specimen conduct after the wire has fused. An overload type instrument is suitable for this purpose. A convenient circuit diagram is given in Fig. 7. An alternate test circuit arrangement is given in Appendix G.

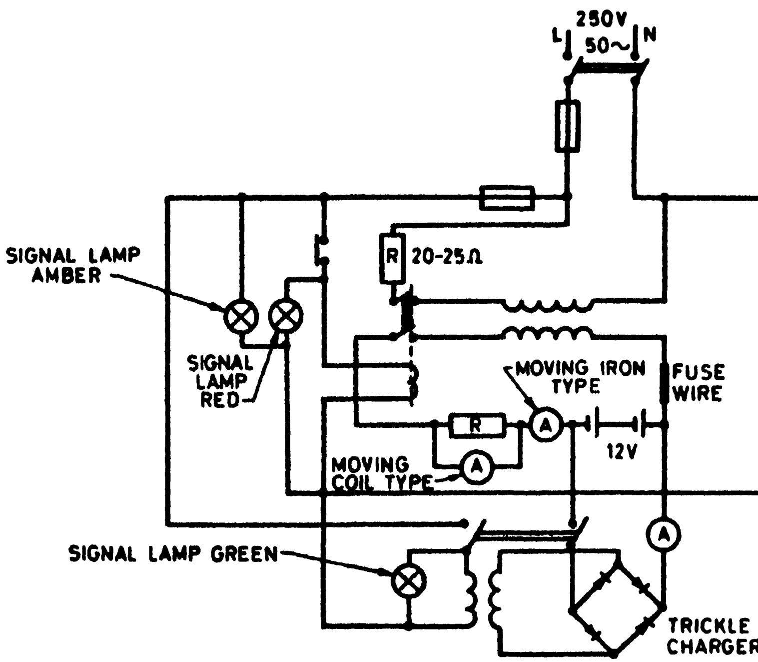


FIG. 7 CIRCUIT DIAGRAM FOR FUSE WIRE TEST

C-4. TEST PROCEDURE

C-4.1 The specimens are set up in the clamp with the fuse wire in position and the ac and dc supplies are switched on simultaneously. When the fuse has blown, the supplies shall be maintained for 5 seconds and any continuation of current flow observed on the overload

instrument. If fault current is observed then the supplies shall be switched off for 5 seconds and then reapplied for 5 seconds so that the presence of conduction may be detected after fall in the specimen temperature. The test shall be repeated on the same board of specimens at intervals of 1 and 2 minutes until either conduction occurs or 10 wires have been fused. The ten fusings shall be comprised only of wires that have fused at the same site on the surface of the specimen. Particles of foreign matter resting and adhering to the surfaces of the specimen shall be scraped off between each test. The piece of the material under test is considered to make a suitable scraper since in this way contamination of the specimen is avoided. The number of applications of the test withstood by the specimens without conduction occurring shall be recorded. Record shall also be made of conduction (fault current) and the condition under which it occurs. A specimen shall withstand the test in the manner defined in C-1.1.

C-5. DETAILS OF THE SPECIAL TRANSFORMER

C-5.1 The core of the main transformer (*see* Fig. 8) is of simple rectangular shape made up from strips of Unisil 62 in such a way as to have a single air gap of approximately 1.6 mm. Both windings are on one limb on a spool consisting of 100 × 120 mm diameter P.B.P. tube with 245 mm diameter and 12.5 mm thick P.B. fabric end cheeks. The secondary winding which is wound on first in order to keep its resistance to a minimum has 250 turns of 9.6 × 3.2 mm enamelled copper strip. Over this is wound, a primary of 125 turns of 1.80 mm insulated copper wire. The air gap is adjusted so as to obtain a magnetizing current of 5.6 A for 180 volts applied to the primary.

C-6. DETAILS OF THE BATTERY

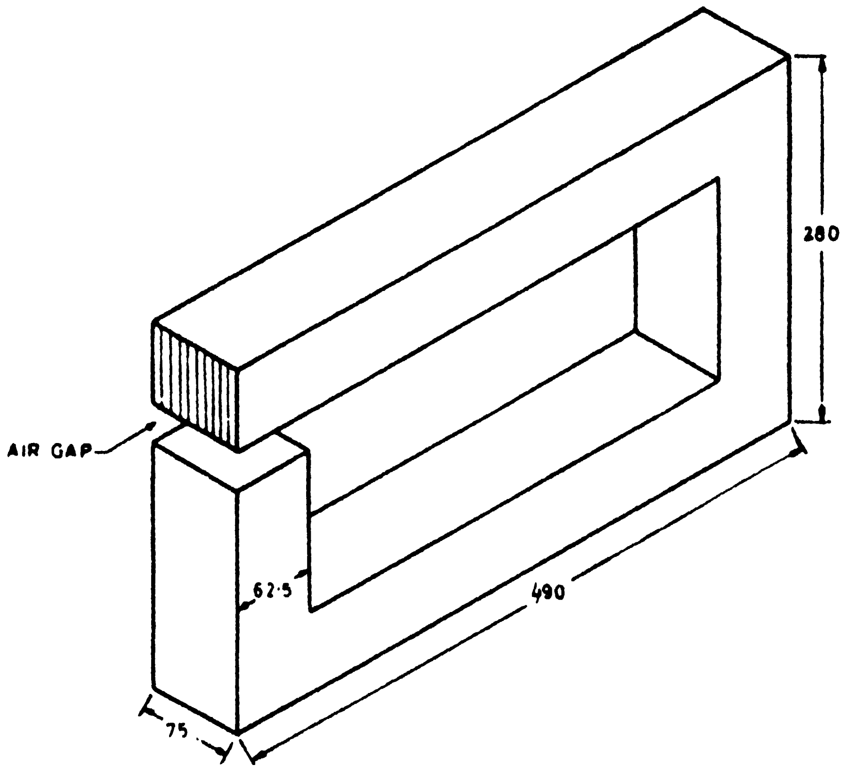
C-6.1 A 12-V battery of about 40 Ah capacity is necessary. It should be capable of a high rate of discharge. A trickle charger that may be left overnight is convenient although a rapid charge would be an alternative. A suitable charging circuit is also included in Fig. 7. Connecting leads in the main battery circuit shall be of adequate size and kept as short as possible.

APPENDIX D

(*Clause* 3.6.1)

GLOWING HOT BODY TEST

D-1. The specimen shall be conditioned in accordance with Appendix F before the test is carried out.



All dimensions in millimetres.

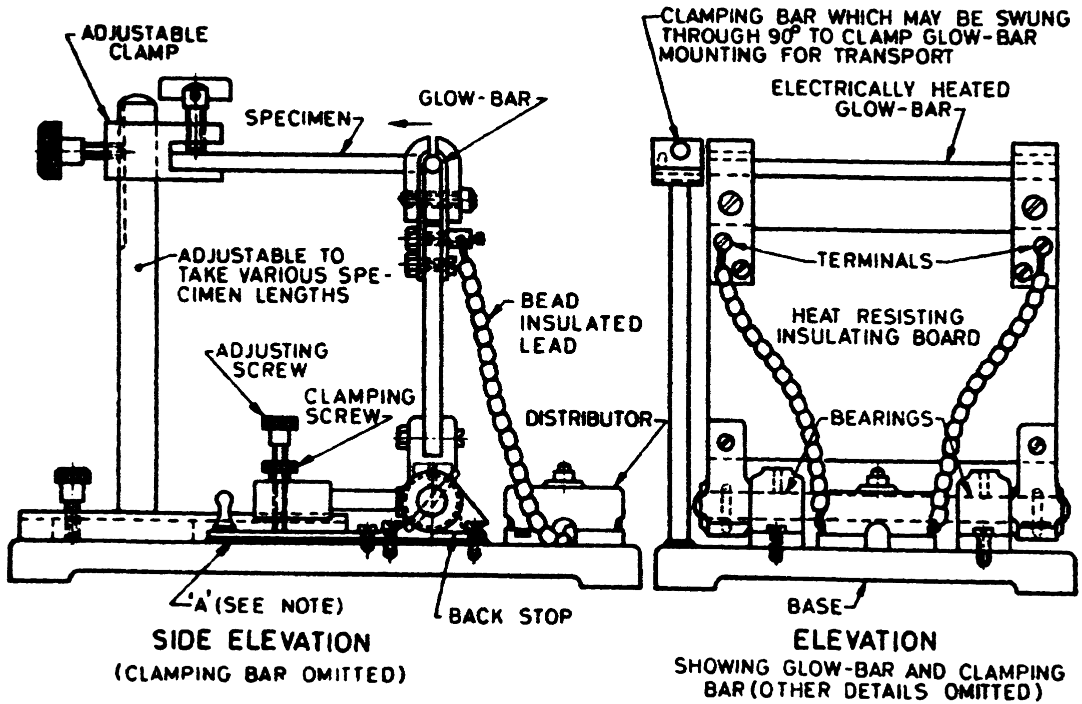
FIG. 8 TRANSFORMER CORE

D-2. The specimen shall consist of a piece of the material of 120 × 15 × 10 mm dimensions, or alternatively, for thinner materials, 120 × 15 × 3 mm dimensions.

D-3. The specimen shall be clamped at one end in a horizontal position and it shall be arranged that the surface of the free end shall make contact at the centre of 15 mm sides with a glowing bar held horizontally at right angles to the specimen.

D-4. The glow-bar shall consist of an electrically heated rod of diameter 8 mm and heated length of 80 mm whose temperature-current relationship is known and reasonably constant.

D-5. Suitable apparatus incorporating a glow-bar of silicon carbide is shown in Fig. 9.



NOTE — The thickness of the adjusting bar 'A' is such that on its removal, the glow-bar moves in direction of arrow a distance of 5 millimetres.

All dimensions in millimetres.

FIG. 9 APPARATUS FOR GLOWING HOT BODY TEST

D-6. The hot rod at a temperature of 650°C shall be placed against the test sample. If no ignition occurs during one minute the temperature of the bar shall be raised in steps of 50°C and the test again carried out on a new, cold test sample until the material inflames. After each test the resulting ash shall be removed from the hot rod. The ignition time shall be deemed to be the time in seconds from the instant of application of the glow-bar to the specimen to the instant of ignition. The extent of the destruction shall be measured by the length of the charred portion in centimetres, or by the loss of weight of the specimen.

APPENDIX E

(*Clause* 3.7.1)

RADIANT HEAT TEST

E-1. Test pieces shall be conditioned in accordance with Appendix F before the test is carried out.

E-2. The size of specimen will depend largely on circumstances, but may conveniently be 50 mm long, 15 mm wide and of thickness equal to the thickness of the material, provided it is not more than 12.5 mm thick, in which case the specimen should be cut down to 12.5 mm thickness.

E-3. The test specimen shall be fixed centrally in the heating tube of the apparatus shown in Fig. 10 and 11 with its long axis vertical, and shall be supported throughout the test.

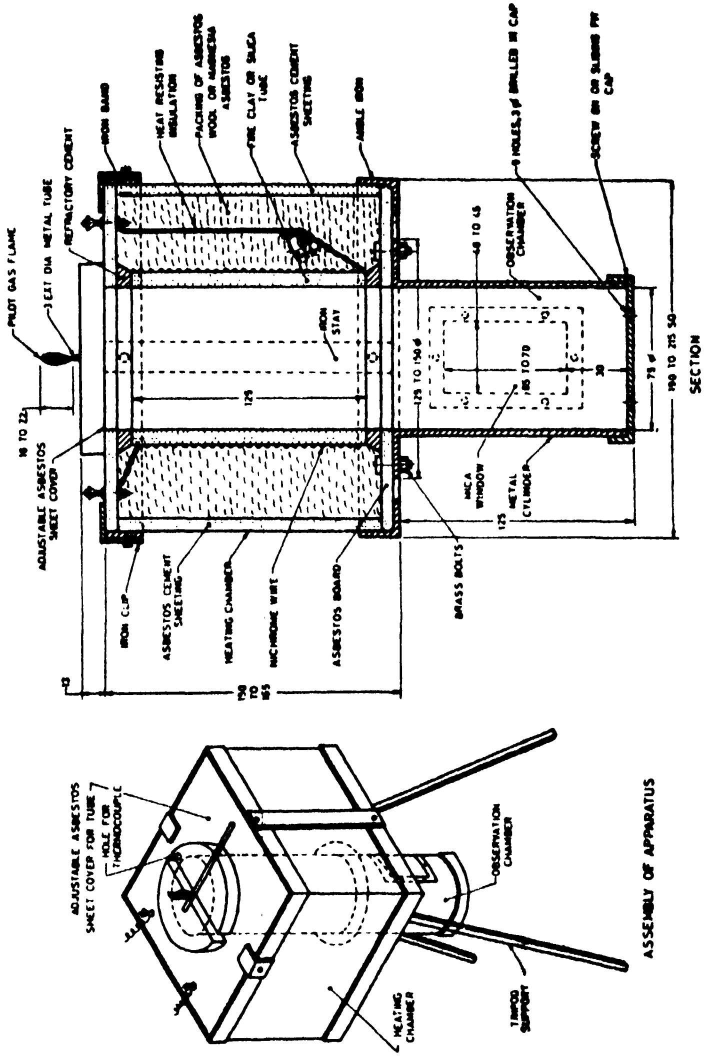
E-4. A light stirrup of nichrome wire, supported by a length of nichrome wire passing through the slit in the adjustable cover, may be used for supporting the specimen.

E-5. During the test the adjustable cover shall be so arranged that there is an opening about 6.5 cm^2 in area.

NOTE — Certain variables, such as the position of the pilot flame, location of thermocouples, and the nature and extent of the intake and exhaust air-orifices, should be fixed when specifying this test.

E-6. The apparatus is heated by passing a suitably regulated electric current through the nichrome resistance wire surrounding the heating tube.

E-7. The temperature of the tube shall be increased at the uniform rate of 300°C per hour and the temperature at which the material ignites noted. The temperature of the tube shall be taken as that shown by a thermocouple situated at the level of the centre of the specimen and equidistant from the inner surface of the heating tube and the middle of the nearest 13 mm face of the specimen. The wires of which the thermocouple is made shall be between 1.40 mm and 0.45 mm and shall be bare for a length of 25 mm from the junction.



All dimensions in millimetres.

FIG. 10 RADIANT HEAT APPARATUS

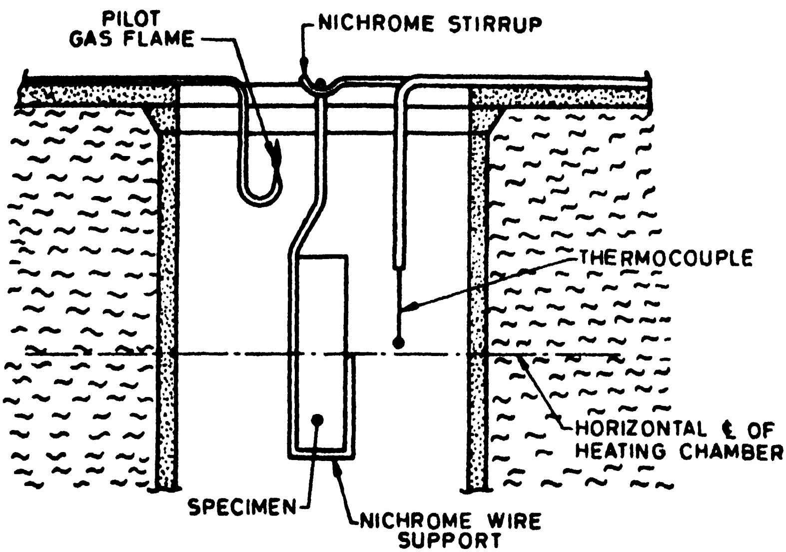


FIG. 11 RELATIVE POSITION OF SPECIMEN, THERMOCOUPLE AND PILOT FLAME IN FLAMMABILITY TEST APPARATUS

APPENDIX F

(*Clauses* A-1.1, B-1.1, C-1.1, D-1 *and* E-1)

METHOD OF CONDITIONING TEST PIECES

F-1. Condition the test pieces in a controlled atmosphere of relative humidity 65 ± 5 percent and temperature of 27° ± 2°C for 18 to 24 hours. Arrange them so as to expose the maximum possible surface to the controlled atmosphere. Test every test piece in the controlled atmosphere or within 3 minutes of removal from it.

F-2. When a complete test room having the controlled atmosphere is not available, the specified relative humidity of 65 ± 5 percent at 27° ± 2°C may be obtained in the enclosed test chamber as follows:

a) Prepare a saturated solution by boiling in water a mixture of 4 parts by weight of sodium chloride and 9 parts by weight of sodium nitrate. Cool the solution and add more of the solid mixture than may be taken into solution.

b) Expose the saturated solution so that the maximum surface is in contact with the air in the chamber, for example, by covering the floor of the chamber with a tray containing the saturated solution. Maintain excess of solid salt in the liquid so that the solution remains. saturated and ensure that the solid remains covered by the solution and that the surface of the liquid is free from any crust or film of grease, dirt, etc.

c) Take care to allow free access of the conditioning atmosphere to all the test pieces. To ensure uniform conditions throughout the chamber, use a fan to circulate air over the surface of the saturated solution and around the test pieces.

d) The correctness of the humidity of the air should be checked from time to time.

APPENDIX G

(*Clause* C-3.1)

ALTERNATIVE TEST CIRCUIT FOR FUSE WIRE TEST

G-1. GENERAL

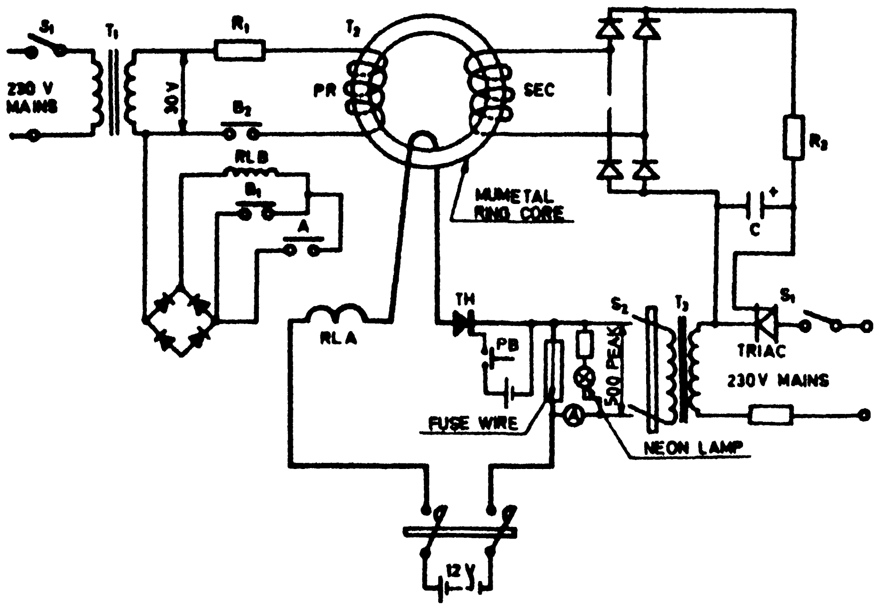
G-1.1 The principle of the test employing the alternative circuit is same as in Appendix C, except that the bulky transformer used in the test circuit of C-3.1 and C-5 is replaced by a mumetal ring core. An ordinary ammeter can be used in place of an overload type of ammeter.

G-2. ELECTRICAL CIRCUIT

G-2.1 An alternative circuit diagram is given in Fig. 12.

G-2.2 The operation is started by pressing the push button PB momentarily which fires the thyristor *TH*. Instantaneously a current of 100 A starts flowing in the fuse wire circuit. The relay *RLA* picks up and closes the contact *A* energizing relay *RLB*. This switches on the 30 V ac supply to the primary of the mumetal ring core through contact *B2* while its contact *B1* locks it. The dc field in the mumetal ring core saturates it. *R1* limits the current in the primary circuit. As soon as the fuse is blown, the core comes out of saturation increasing the reactance of its primary winding. A small voltage is induced in the secondary which after rectification gives a dc signal to the triac. The primary of the transformer *T2* gets the supply and the ac voltage of 500 V (peak) appears across the fuse terminals. By this time the thyristor is switched off. A deliberate delay is introduced for the triac

gate signal through *R2-C* to allow the thyristor to go cut of conduction stage. The current is read in the ordinary moving iron ammeter.



T_1 — Transformer 230/30V 30VA

T_2 — Mumetal ring core
Size 120 mm O.D. × 70 mm ID × 19·5 mm
Primary turns 400 — 23 SWG
Secondary turns 400 — 23 SWG

T_3 — Transformer 230/355V 500 VA

RLA — 100 A current operated relay

RLB — Relay
30 Volt dc working with three n.o. contacts

R_1 — 300 ohms 5 watts

R_2 — 22 ohms 5 watts

C — 100 mfd 50V dc electrolytic capacitor

Triac — 400 V, 2·5 A

TH — Thyristor 125 A 800 V PIV

Diodes — 500 mA 100 V PIV

PB — Push Button

FIG. 12 ALTERNATIVE CIRRUIT DIAGRAM FOR FUSE WIRE TEST

G-3. TEST PROCEDURE

G-3.1 The specimens in accordance with C-1 are set up in the clamp (*see* C-2) with the fuse wire in position and the ac and dc supplies are switched on Switch *S2* is closed and the push button PB is pressed. When the fuse has blown the indication appears by the glowing of lamp '*L*'. The supplies shall be maintained for 5 seconds and any continuation of current flow observed on the ammeter. If the fault current is observed, then the switch *S2* is opened for 5 seconds and again closed for 5 seconds so that the presence of conduction may be detected after the fall in specimen temperature. For the next operation *S1* and *S2* are opened and the fuse is replaced. The test shall be repeated on the same board of specimens at intervals between 1 and 2 minutes until either conduction occurs or 10 wires have been fused. The ten fusings shall be comprised only of wires that have fused at the same site on the surface of the specimen. Particles of foreign matter resting and adhering to the surfaces of the specimen shall be scrapped off between each test. The piece of the material under test is considered to make a suitable scraper since in this way contamination of the specimen is avoided. The number of applications of the test withstood by the specimens without conduction occuring shall be recorded. Record shall also be made of conduction (fault current) and the condition under which it occurs. The specimen shall withstand the test in the manner defined in C.1.1.

G-4. DETAILS OF THE BATTERY

G-4.1 A 12V battery of about 40 Ah capacity is necessary. It should be capable of a high rate of discharge. A suitable charging circuit is also included in Fig. 7.

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